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Further Study on Anthropogenic Contributions to Extreme Rains over Northeast Colorado in September 2013

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Two modeling studies have led to opposite conclusions concerning human effects on the extreme Northeast Colorado rainfall event of September 2013. Results derived from analysis of historical 1° resolution AMIP simulations (GEOS-5) indicated 5-day rainfall extremes over the region during September were less likely in the early 21st century than during the late 19th century, implying long-term climate change reduced the risk of the 2013 event (Hoerling et al. 2014). In contrast, results from intercomparing two parallel suites of initialized WRF simulations, with and without effects of anthropogenic driving, indicated an increased frequency of an extreme event akin to September 2013 (Pall et al. 2017). The methods of the two studies are fundamentally different, involving both distinct experimental designs and also asking somewhat different questions about anthropogenic climate change effects. For instance, the latter study employed a conditioning on the large-scale atmospheric circulation that was a key factor in understanding the rains while the former allowed the statistics of heavy rain generating circulation systems to vary with time and external forcing. Here we will present additional results from further analysis of the Colorado extreme rain event based on new climate model experiments that test the robustness of previous findings. These address the sensitivity of attributing climate change effects on extreme rainfall to model architecture and to experimental design. First, we repeat the diagnosis of Hoerling et al. but use long historical ~1° AMIP simulations run with CAM5. Second, extreme rainfall statistics are intercompared between two parallel climate experiments (as also considered in Pall et al, though these new experiments are uninitialized) in which one uses the observed boundary forcing in one set (so-called factual experiments) and non-anthropogenic forcing in the second set (so-called counterfactual simulations). Uncertainty resulting from the use of different models is again addressed in these factual vs counterfactual experiments — two different climate models are used: CAM5 and ECHAM5, and also the CAM5 experiments are repeated at ~0.5° resolution. By contrasting different approaches to studying this hydrometeorological event, our goal is to acquire a better understanding of gaps limiting reliability in attribution for situations involving complex interaction with topography, convection, and large-scale circulation.